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HEADQUARTERS
AIR PROVING GROUND COMMAND
Eglin Air Force Base, Florida

FINAL REPORT
ON
OPERATIONAL SUITABILITY TEST OF
TRUCK-TRACTOR WRECKER, TYPE M-246
AND COMPARATIVE EVALUATION OF TRUCK-MOUNTED
BOMB HANDLING CRANE, TYPE H-108

PROJECT NO. APG/CSC/344-A

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6 October 1954

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TRUCK-TRACTOR WRECKER, TYPE M-246
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BOMB HANDLING CRANE, TYPE M-108

1. The object of this test was to determine the operational suitability of the M-246 Truck-Tractor Wrecker, and to compare the M-246 with the M-108 Truck-Mounted Bomb Handling Crane.
2. The M-246 is a new piece of equipment incorporating modern engineering trends of truck-mounted cranes. Due to the versatility of the M-246, it has been found suitable to replace the C-2 Truck-Wrecker, and to supplement or replace the M-108 Truck-Mounted Bomb Handling Crane, thereby providing maintenance and bomb handling personnel with means to better accomplish their mission.
3. The M-246 can be integrated into the Air Force supply system without affecting present logistical and personnel planning.


PATRICK W. TIMBERLAKE
Major General, USAF
Commander

HEADQUARTERS
AIR FORCE OPERATIONAL TEST CENTER
AIR PROVING GROUND COMMAND
Eglin Air Force Base, Florida

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SUMMARY

1. INTRODUCTION: The M246 truck-tractor wrecker has been procured in quantity to replace the C-2 truck-tractor wrecker throughout the Air Force. This test was established as the result of a munitions handling equipment conference conducted at Headquarters APGC by personnel of Headquarters USAF. It was the recommendation of this conference that the M246 be also considered as a replacement item for the truck-mounted bomb handling crane, type M108.

2. PURPOSE AND DESCRIPTION: The M246 is a medium capacity truck-tractor wrecker intended for general utility in reclamation, maintenance, and supply activities. It consists of a hydraulically-operated crane unit mounted on a standard five-ton, 6x6 Ordnance Department truck chassis. The vehicle is provided with a fifth-wheel plate attached to the truck frame behind the crane assembly for the purpose of towing a semitrailer. The normal rotation of the crane is restricted to 270°; however, 360° travel is possible by removal of stops. The boom can be raised from the horizontal position to an inclined angle of approximately 45°. In addition to the vertical movement of the boom, the boom can be extended from 11½ feet to 19 feet hydraulically and from 19 feet to 26 feet manually. The crane is normally rated at a 10,000-pound capacity; but, as a fixed crane, it was designed to have maximum lifting capacity of 20,000 pounds with 15-foot boom extension, jacks positioned, rear outriggers up, and using a three-part line. Power for the crane is supplied by a hydraulic pump driven by a power take off from the truck engine. The weight of the M246 is 32,000 pounds and it is 29 feet 7 inches long, 8 feet 2½ inches wide, and 11 feet 2 inches high. The M246 is a larger vehicle than the M108, although similar in many respects, as shown in Figures 1 and 2. Only the M246 is capable of towing a semitrailer.

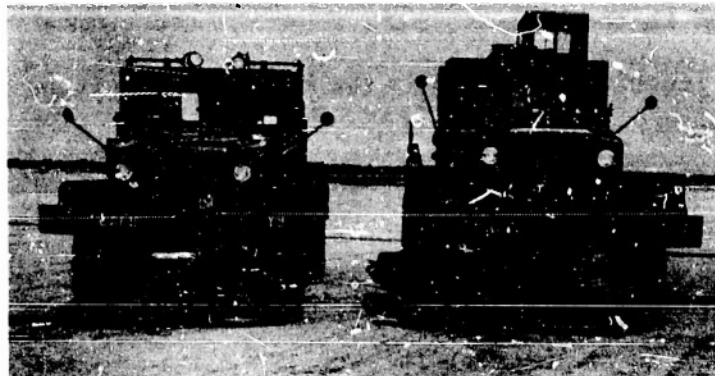


Figure 1. Front view, M108 on left, M246 on right.

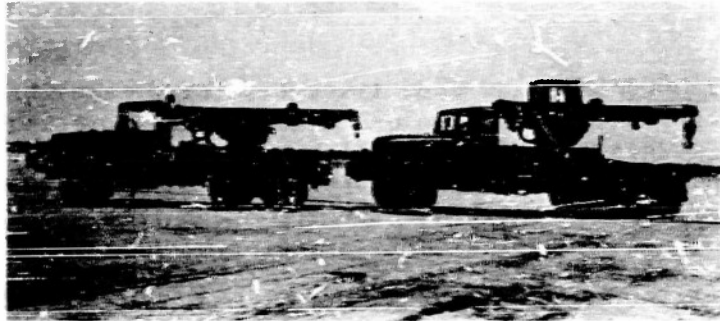


Figure 2. Left side view, M108 on left, M246 on right.

3. **OBJECT:** To determine the operational suitability of the M246 truck-tractor wrecker and compare the M246 with the truck-mounted bomb handling crane, type M108 to determine if the M246 can replace the M108.

4. **CONCLUSION:** When modified as recommended in Appendix D of this report, the M246 will be operationally suitable as a medium capacity truck-tractor wrecker. The M246 will also be operationally suitable as a bomb handling crane; it can replace the M108.

5. **RECOMMENDATIONS:**

- a. The M246 be retained as a truck-tractor wrecker.
- b. The M246 replace the M108 as the standard bomb handling crane as the requirement demands.
- c. The modifications detailed in Appendix D of this report be incorporated in the M246.
- d. Technical orders for the M246 crane unit be published.

DISCUSSION

1. ORGANIZATIONAL IMPACT:

a. Personnel: Personnel requirements for the operation and maintenance of the M246 wrecker are no greater than those now in effect for similar equipment.

b. Training: Training requirements for personnel operating the M246 are comparable to those for currently used truck-mounted crane equipment and can be accomplished by using organizations.

c. Equipment and Facilities: The M246 wrecker can be maintained by organizations now employing similar equipment without the addition of specialized equipment or facilities.

2. CAPABILITIES AND LIMITATIONS:

a. Capabilities:

- (1) The M246 wrecker is capable of performing bomb-handling operations up to 10,000 pounds. The unit can be maneuvered satisfactorily in ammunition areas and around parked aircraft.
- (2) The truck has adequate power for towing the C-2 type semitrailer loaded to its maximum capacity of 25,000 pounds. It has excellent cross-country characteristics in sand and lightly wooded areas.
- (3) The M246 is capable of performing necessary hoisting tasks required in flight line maintenance and base supply areas within its reach and lifting capacities.

b. Limitations: Within its design capabilities the M246 has few limitations. It has some features, however, that do affect its operational usefulness. They are:

- (1) The visibility from the cab is restricted and the operator cannot readily see the end of the boom when it is in the fully raised position. He must lean forward and assume an awkward position, which interferes with efficient operation of the controls.
- (2) The heavy, cumbersome, manually operated outriggers on the M246 are difficult to position. Their frequent use warrants replacing them with hydraulically operated outriggers.

- (3) It is difficult for the operator to determine the length of the boom since there is no device to indicate boom extension. This tends to slow operation when maximum loads or boom extension are desired.

3. COLLECTIVE ANALYSIS:

a. General: The USAF has a continuing requirement for a medium capacity truck-tractor wrecker. This requirement has been fulfilled in the past by the C-2 wrecker. These, however, have become obsolete and the M246 was procured as a replacement. The M246 is more versatile than the C-2 in that it is equipped with a wider swiveling boom and is hydraulically operated. These features permit a wide range of operation and more precise handling of loads. This includes handling munitions, where a swinging boom and precision movement of the load are desirable. The towing capability is adequate and the mobility of the vehicle over adverse terrain will permit satisfactory operation on and off Air Force bases. Although the M246 has certain characteristics that affect its operational use, its versatility and general utility in Air Force Operations will offset these limitations. Its inability to lift 20,000 pounds as a fixed boom crane is not considered a serious limitation; the approximately 14,000-pound capacity available as a hoist will be adequate for routine operations.

b. Truck-Tractor Wrecker: The hydraulic operation of the M246 crane unit is much smoother and more easily controlled than the mechanical operation of the C-2 wrecker which it replaced. The lifting capacity of the M246 is only slightly greater than the C-2 which is rated at approximately 10,000 pounds at 8-foot boom extension. The M246 is capable of removing and replacing engines on most of the larger type aircraft in the Air Force in use at present. The boom extension required and the weight of some engines exceed the safe load restriction (reference Table 1, Appendix B). Similar restrictions will be encountered in airframe erection or removal of crashed aircraft from runways. The M246 with a 10,000-pound maximum capacity, however, is suitable as a medium capacity crane.

c. Bomb Handling Crane: The hydraulic operating systems of the M246 truck-tractor wrecker and the M108 bomb handling crane are very similar. The increased capacity of the M246 is necessary to allow handling of munitions now being considered as weapons in the USAF. Cranes of 10,000-pound capacity will be adequate for practically all conventional munitions handling. The M246 with greater lifting capacity, equally smooth operation, the same maintenance requirements and no greater operating crew requirements, can replace the M108 as a bomb handling vehicle.

4. BASIS OF ISSUE: The basis of issue of the M246 should be identical to the bases of both the C-2 and/or M108 vehicles, whichever it replaces.

APPENDICES:

- A. Test Procedure
- B. Test Results and
Discussion of Results
- C. Related Tests
- D. Recommended Modifications

W B Putnam
W. B. PUTNAM
Colonel, USAF
Commander

TEST PROCEDURE

1. The M246 wreckers utilized in this test were shipped to the Air Proving Ground Command by rail.
2. The wreckers were inspected for completeness and checked for any functional discrepancies by base automotive maintenance personnel.
3. A manufacturer's representative held a school for the purpose of indoctrinating using personnel in the operation and care of the M246.
4. The units were tested during July and August 1954 in the temperate climate at Eglin Air Force Base, Florida.
5. During the testing, the M246 was used in handling munitions, aircraft salvage and aircraft repair.
6. The M246 was compared with the M108 in the handling of bombs and munitions to determine if the M246 could replace the M108 as bomb handling equipment.
7. The maximum capacity of the M246 was determined by measuring its hoisting effort on a calibrated dynamometer.

TEST RESULTS AND DISCUSSION OF RESULTS

1. TRANSPORTABILITY: The M246 was measured and weighed and found to be within weight and dimensional limitations for airlift by C-124 aircraft, for rail shipment, and for hauling or driving over roads.

2. OPERATING CHARACTERISTICS:

a. Crane Unit: The crane units were suitable as rotating cranes while lifting loads up to and including 10,000 pounds; however, they were not capable of lifting 20,000-pound loads as fixed boom cranes (reference paragraph 7c, Appendix B). The precise and smooth hydraulically controlled M246 expedited the removal and replacement of aircraft engines. During the test the M246 was used to remove and replace engines on C-47, SA-16, C-124 and B-47 type aircraft. Aircraft maintenance personnel stated that within its capability the M246 as a medium capacity crane can perform many tasks involved in flight line maintenance.

b. Roadability: While being driven over narrow, high-centered, gravel, sand, and loose sand roads, the M246 wrecker exhibited roadability characteristics similar to those of the standard five-ton, 6x6 truck. The wrecker was used to tow a 40-foot semitrailer carrying its maximum load of 25,000 pounds. In towing the loaded semitrailer, the M246 traversed such paved and unpaved roads as could be found on and around Eglin Air Force Base. One of the test items was used to tow a semitrailer to the scene of a crashed RB-57 aircraft. The crash occurred in a wooded area several hundred yards from the paved highway. The M246 broke a trail to the crash and was then used to load wreckage (approximately 12,000 pounds) on the trailer, after which it pulled the loaded trailer out of the wooded area and returned to the base.

c. Maneuverability: The M246 wrecker has a turning radius of 35 feet 6 inches and was capable of maneuvering satisfactorily in all conditions encountered in bomb storage, flight line maintenance, supply, and reclamation areas.

3. OPERATING PRECAUTIONS:

a. To assure operation within the capacity of the crane, the operator must first ascertain the weight of the object to be lifted. A chart in the cab will indicate to him the maximum safe boom extension for that specific weight.

b. One operator attempted to lift an object too heavy for a boom extension of 19 feet. The boom was bent without lifting the object. Since the lifting was attempted with the boom directly to the rear of the truck, the truck did not tip to indicate that the boom was being overloaded. The actual weight of the object was unknown and could not be determined at the time. This will often be the case in aircraft salvage operations. Thus referencing safe load chart in the cab would not have prevented the overload.

c. If it is assumed that the operator knows the exact weight of the object to be lifted, he must then be able to determine the extension of the boom. Three extension lengths are easily known: (1) 11 feet 6 inches (minimum); (2) 19 feet (maximum hydraulic extension) and (3) 26 feet (hydraulic plus manual extension). No indication is available to determine the length of any intermediate position.

4. OPERATOR TRAINING AND PERSONNEL REQUIRED:

a. Operator Training and Procedures: No more training is needed in learning to operate the M246 than the M108. Corresponding to the M108, the M246 truck and crane are both well placarded as to operating procedures. Operators from the using organizations of the Air Proving Ground Command attended a school conducted by a manufacturer's representative. The school lasted for eight hours. All operators who attended the school stated that a formal instructional period of this nature was more effective than passing the instructions from one operator to another. At several of the auxiliary bases where a representative could not visit, the operators used self-instruction periods. They carefully studied the manufacturer's Operating and Service Instructions and read the placards posted in the truck and crane, after which they experienced no difficulty in operation of the M246.

b. Personnel Required to Operate the M246: For safe and efficient operation of the M246 wrecker, a two-man crew is required, one operator and one helper. In instances where the boom jacks are used, a third man is required.

5. SUITABILITY OF CRANE COMPONENTS:

a. Hydraulic System: The hydraulic system functioned satisfactorily on the five test items during the test. However, when lifting maximum loads and using any two motions of the crane, such as swing and boom or hoist and swing, the movement was greatly restricted. The hydraulic hoses, as installed, withstood the pressures exerted on them; no breaks were experienced but several leaks were found where hoses connected to lines and valves. At the start of the test the M246

wreckers were new, and throughout the test they required frequent tightening and replacement of gaskets and packings to prevent hydraulic fluid leakage.

b. Crane Operator's Visibility: The crane operator's visibility to the left is restricted approximately 90 percent because of the crane boom. This situation cannot be corrected without redesigning the complete crane. When the boom is raised to the full up position, the operator is unable to see the end of the boom or the block. The visibility for this position can be improved by redesigning the top of the cab to include a window, which could be installed on hinges to permit opening during hot weather for ventilation. Forward and to the right, visibility is good.

c. Lights: Several operations of handling bombs and supplies were conducted at night, and the lights as installed on the truck and crane were satisfactory.

d. Outriggers: The design of the outriggers on the M246 is very similar to the M106. They are heavy and cumbersome for manual operation. The design of the outriggers is such that they tend to collect dust, dirt, and other foreign material, making their operation difficult, and tending to discourage their use. The base plates for the two rear outriggers are stowed just above the front outriggers and must be carried to the rear when needed. Each of the base plates weighs 51 pounds. There are numerous pins to be inserted in setting the outriggers; these pins must be kept clean, oiled and stowed in the accessory box. During the test it was found that the pins were frequently lost or misplaced and operation was delayed until they were located. Since this vehicle incorporates a system of hydraulic power for load handling, the addition of hydraulically-operated outriggers would require only slightly more engineering effort and would provide a superior system of outrigger control (reference Figure 3).

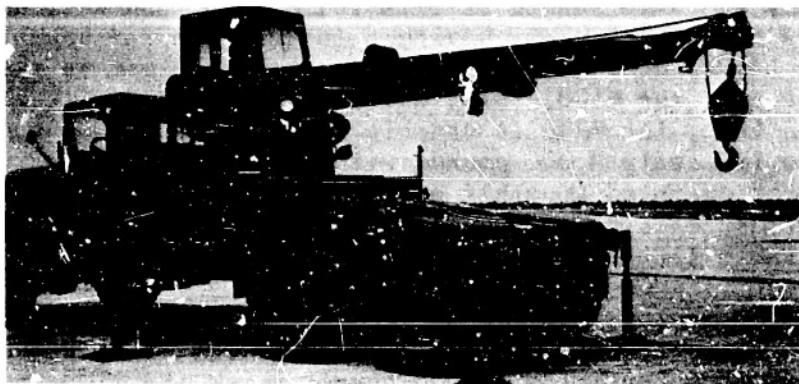


Figure 3. M246 with outriggers set.

c. Boom Jacks: To place the boom jacks requires three men and consumes approximately 30 man-minutes. This task, similar to setting the outriggers, is tedious and, if care is not taken, personnel can be injured by the heavy telescoping tubes and jack feet (the same feet or plates are used for the outriggers). Each of the telescoping tubes weighs 117 pounds. Once the boom jacks are set the crane becomes a fixed boom crane and only the winch is used. Any load requiring the use of boom jacks usually has considerable bulk and in most instances it was found that there was not enough space between the boom jacks and the end of the boom to afford a suitable working area (reference Figure 4).



Figure 4. The M246 with boom jacks set.

6. COMPARISON OF THE M246 AND M108:

a. Bomb Handling in Storage and Bomb Disposal Areas and at Railheads: The M246 and M108 were both used in bomb disposal areas and at railheads for unloading and storage of bombs. Both trucks require approximately the same length of time for parking and setting of outriggers when used. The M246, having a longer boom and capable of lifting greater loads, does not need to be parked as close to the object to be lifted as does the M108. With outriggers down and with the boom extended to 26 feet, the M246 is capable of lifting 4,500 pounds while the M108 can lift only 4,000 pounds with the boom extended to 16 feet. The two cranes operated smoothly and efficiently, and, within their load capacities, each can move approximately the same number of units (reference Table 1).

b. Bomb Servicing to Various Types of Aircraft: Bomb servicing to various types of aircraft was very similar; the M246 was capable of delivering bombs weighing 10,000 pounds where the M108 was restricted

to smaller bombs. The M246 having the longer boom and greater capacity could unload bombs faster because it did not have to move as often as the M108. The larger size of the M246 did not impair its movement in the vicinity of parked aircraft.

c. Towing Trailers: During the test the M246 was used to spot a 40-foot C-2 type semitrailer near a stack of bombs in the ammunition area. After unhooking from the trailer, the M246 was used to load a maximum load of bombs on the trailer (25,000 pounds). It then towed the trailer to the flight line and simulated unloading for use on aircraft. A modification, consisting of lowering the pintle hook, was necessary on the M108 before it was capable of towing the trailer, bomb, type M5, 2½-ton. The M108 is capable of towing two of the M5 type trailers loaded. When large quantities of bombs are required, the M246 can deliver them more rapidly.

7. LOAD CAPABILITIES OF THE M246:

a. Without Outriggers: In the manufacturer's handbook of Operating and Service Instructions it is stated that the M246 in this condition is capable of lifting loads varying from 1,700 pounds to 5,200 pounds (reference Table 1). A test was made to confirm these various loads and boom radii. In all instances the loads were lifted only a short distance from the ground because the truck tipped to what was considered to be a dangerous position (reference Figures 5 through 8).

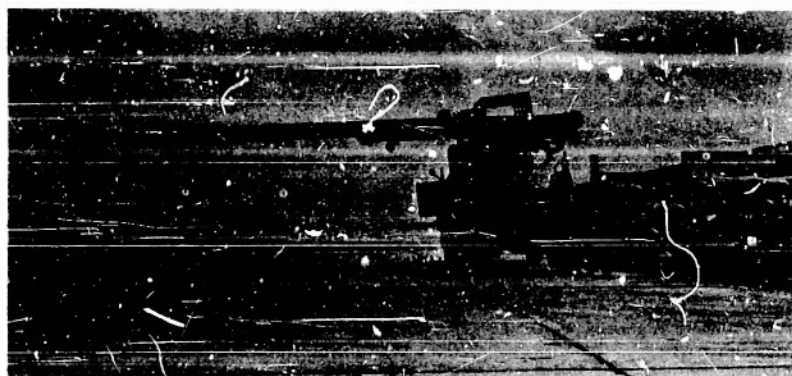


Figure 5. Boom extended 26 feet lifting 1,700 pounds.

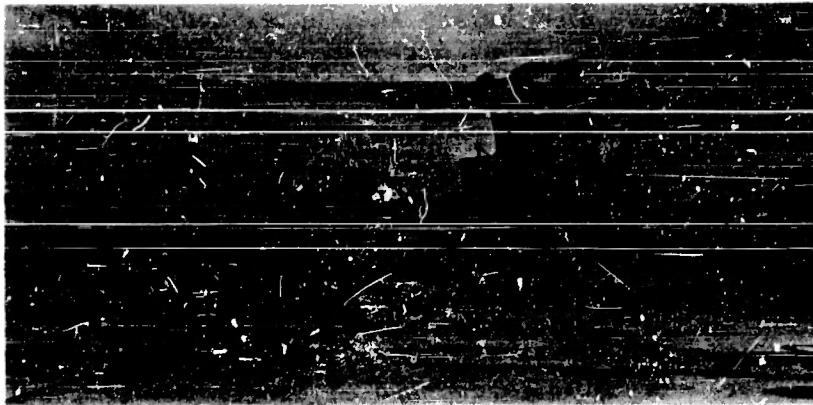


Figure 6. Boom extended 23 feet lifting 2,000 pounds.

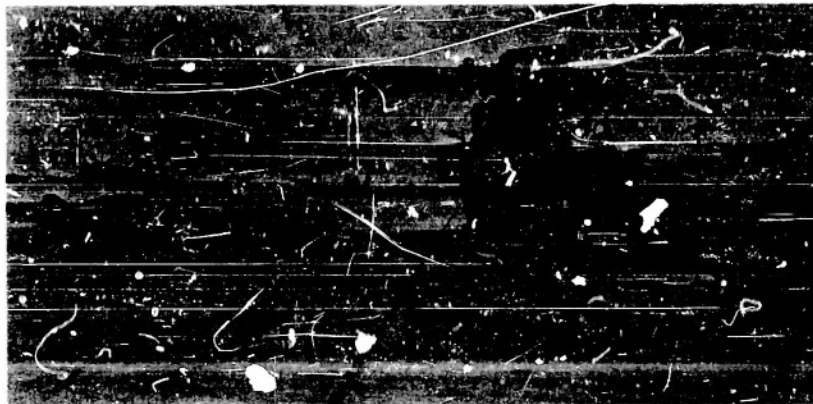


Figure 7. Boom extended 19 feet lifting 2,500 pounds.



Figure 8. Boom fully retracted, 11 feet 6 inches, lifting 5,200 pounds.

b. With Outriggers: When outriggers were in place the M246 lifted the loads as outlined by the manufacturer (reference Table 1 and Figures 9 through 12).



Figure 9. Outriggers down, boom extended 26 feet, lifting 4,500 pounds.

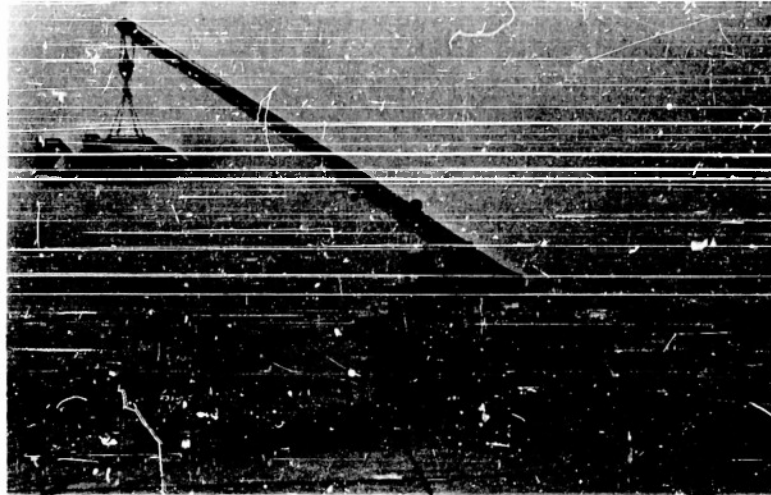


Figure 10. Outriggers down, boom extended 26 feet and raised to 45° angle, lifting 4,500 pounds.

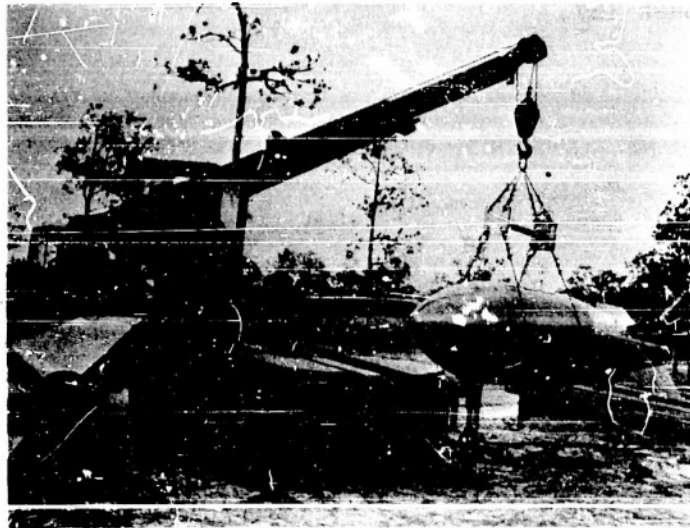


Figure 11. Outriggers down, boom fully retracted, lifting 10,000 pounds.

c. Maximum Capacity of the M246: The manufacturer's Operating and Service Instructions state that the M246, with boom jacks to ground, rear outriggers up, and using a three-part line, is capable of lifting 20,000 pounds. The five test items were checked and found to lift 12,800, 13,400, 15,400, 15,700, and 14,000 pounds respectively. None of them was capable of lifting 20,000 pounds (reference Table i and Figure 12). The maximum load capacity is governed by operation of the hydraulic pressure relief valve which is set at 1200 psi. The five test items were checked and it was determined that the hydraulic pressure relief valve was set properly in each case.

TABLE 1

COMPARISON OF RECOMMENDED MAXIMUM LOADS IN POUNDS, FOR THE M246 AND M108

SAFE LOAD CHART FOR M246 *			SAFE LOAD CHART FOR M108		
RADIUS	WITH OUTRIGGERS	WITHOUT OUTRIGGERS	RADIUS	WITH OUTRIGGERS	WITHOUT OUTRIGGERS
11 ft 6 in	10,000	5,200	8 ft	8,000	4,000
12 ft	9,600	4,750	9 ft	7,500	3,750
13 ft	8,800	4,275	10 ft	7,000	3,500
14 ft	8,200	3,800	11 ft	6,500	3,250
15 ft	7,650	3,500	12 ft	6,000	3,000
16 ft	7,200	3,175	13 ft	5,500	2,750
17 ft	6,750	2,950	14 ft	5,000	2,500
18 ft	6,400	2,700	15 ft	4,500	2,250
19 ft	6,000	2,500	16 ft	4,000	2,000
20 ft	5,750	2,300			
21 ft	5,450	2,200			
22 ft	5,200	2,100			
23 ft	5,000	2,000			
24 ft	4,800	1,950			
25 ft	4,650	1,825			
26 ft	4,500	1,700			

* Maximum capacity 20,000 pounds at 15-ft radius with boom jacks to ground, rear outriggers up and 3-part line.

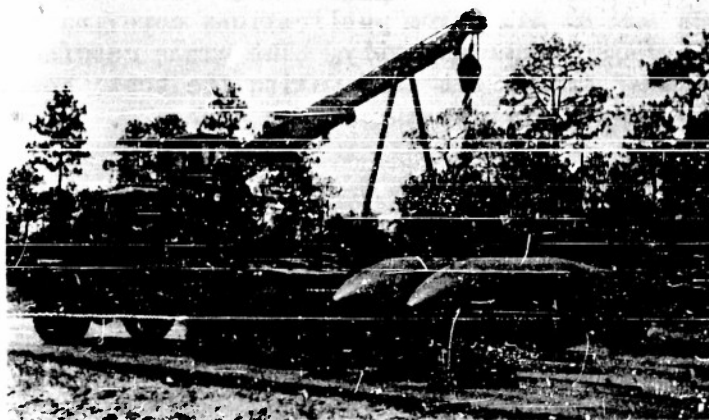


Figure 12. M246 with boom jacks set attempting to lift two 10,000-pound bombs.

8. MAINTENANCE: The maintenance and repair facilities required for the M246 wrecker are comparable to those for other vehicles of similar size and design. No special tools or equipment were required to maintain this unit. Experience gained from the maintenance of the M108 indicated that the maintenance pattern for the M246 would be very much the same. After approximately a year of operation the flexible hydraulic hoses deteriorate and must be replaced. The five hoses which pass through the swivel post to the swivel valve are very difficult to remove and it requires approximately 8 man-hours to replace one hose or all five. The excessive maintenance time required for this task is due to the necessity of the removal and disassembly of the swivel valve to permit reaching the hose or hoses. Maintenance personnel were of the opinion that substitution of metal tubing from the swivel valve to the bottom of the swivel post would reduce this task to approximately 2 man-hours and would reduce the deterioration.

9. SAFETY: The basic safety characteristics of the M246 wrecker are satisfactory, although personnel could be injured in setting up the outriggers and boom jacks.

10. OPERATION AND MAINTENANCE PUBLICATIONS: The truck chassis is covered in Technical Order No. 19-75AA-69, "Five-Ton 6x6 Cargo Truck M41, Cargo Truck M54, Cargo Truck M55, Cargo Van Truck M64, Chassis Truck M39, Chassis Truck M40, Chassis Truck M61, Chassis Truck M63, Dump Truck M51, Medium Wrecker Truck M62, and Tractor Truck M52."

Maintenance personnel are of the opinion that this technical order is adequate. There are no Air Force publications covering the operation and maintenance of the crane assembly. The crane manufacturer's operation and maintenance manual was used during the test; however, it is not adequate for proper maintenance of the crane.

RELATED TESTS

1. Air Proving Ground Command final report on Project No. APG/SSB/140-A, "Operational Suitability Test of Crane, Truck-Mounted, 6,000-Pound Capacity, Type H-3 Hydrocrane," dated 16 January 1952.
2. Air Proving Ground Command letter report on Project No. APG/SSB/140-B, "Operational Suitability Test of Crane, Truck-Mounted, 6,000-Pound Capacity, Type H-3 Hydrocrane," dated 11 March 1952.
3. Air Proving Ground Command letter report on Project No. APG/SSB/38-B, "Operational Suitability Test of Truck, 2½-Ton, 6x6, Crane, T-62," dated 13 March 1952.
4. Air Proving Ground Command termination report on Project No. APG/CSC/242-AB, "Comparative Evaluation of the M108 Crane and H-3 Hydrocrane," dated 17 September 1953.
5. Air Proving Ground Command final report on Project No. APG/CSC/230-C, "Operational Suitability Test of the M108 Truck-Mounted Hydraulic Crane," dated 15 July 1954.

RECOMMENDED MODIFICATIONS

1. A window be installed in the top of crane operator's cab.
2. The outriggers be redesigned including use of hydraulically-operated controls.
3. A device be installed to indicate to the operator the boom extension.
4. The rubber-covered flexible hydraulic lines that run up through the swivel post to the swivel valve be replaced with metal lines.

Project No. AFG/CSC/344-A

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